Citation:

Stockman NK, Schenkel TC, Brown JN, Duncan AM. Comparison of energy and nutrient intakes among meals and snacks of adolescent males. *Prev Med*. 2005 Jul; 41 (1): 203-210. Epub 2004 Dec 10.

PubMed ID: 15917012

Study Design:

Prospective cohort study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

This study examines and compares the distribution of energy and nutrient intakes among meals and snacks, and relate eating occasion frequency to body mass index (BMI) of adolescent males.

Inclusion Criteria:

- Healthy adolescent males
- 14-18 years old
- Informed consent was obtained by all subjects, as well as assent from a parent or legal guardian if subject was younger than 18 years old.

Exclusion Criteria:

- Males younger than 14 or older than 18 years of age
- Males with underlying health problems
- Females.

Description of Study Protocol:

Recruitment

Healthy adolescent males between the ages of 14-18 years were recruited from local high schools and community centers in Ontario, Canada.

Design

Cross-sectional study design.

Dietary Intake/Dietary Assessment Methodology

- Study subjects were provided with food record forms and instructed to record all food and drink consumed for 24 hours on three consecutive days including two weekdays and one weekend day. Forms included areas to indicate the time, type, and quantity of food consumed and preparation method. In addition, subjects were instructed to self-report the type of every eating occasion as breakfast, lunch, dinner, or snack. Before completing the food records, researchers held study orientation seminars for small groups of subjects to explain all aspects of the study and provide training on the completion of accurate food records
- Food models, food labels, standard measuring cups and spoons, as well as bowls and drinking glasses were used in an interactive demonstration to maximize understanding and comprehension of how to complete food records
- Instruction was also provided on how to read food labels and how to record home-cooked recipes. The importance of detail, accuracy and honesty was stressed and questions were encouraged.

Intervention

No intervention, one time (three-day food record) data collected.

Statistical Analysis

- All statistical analyses were performed using the Statistical Analysis System (SAS Institute Incorporated 2001, version 8.2, Cary, NC, USA) with $P<0.05$ considered as statistically significant
- In order to categorize subjects into body weight categories, calculated BMI along with age was plotted on the Centers for Disease Control and Prevention (CDC) Growth Charts for boys, two to 20 years old for determination of BMI-for-age percentiles
- Subjects were classified according to the following body weight categories as outlined by the CDC:
    - Underweight (less than the 5th percentile)
    - Acceptable body weight (5th to <85th percentile)
    - At risk for overweight (85th to <95th percentile)
    - Overweight (>95th percentile)
- All food records were analyzed for energy, protein, carbohydrate, total fat, saturated fat, cholesterol, dietary fiber, calcium, iron and sodium using NutriBase IV Clinical Edition 2001. This food database contains nutrient information for over 30,000 foods, including 6,210 food items for up to 82 food components from the United States (US) Department of

Agriculture Standard Reference, Release 13 Nutrient Database and 4,668 food items for up to 115 food components from the Canadian Nutrient Files

- Intakes of energy and nutrients at breakfast, lunch, dinner and snacks as well as daily totals were computed for each of the three individual days for each subject. Three-day averages and three-day averages expressed as percentages of total intake were then computed for energy and nutrients at all meals and snacks
- Comparison of three-day average energy and nutrient intakes among breakfast, lunch, dinner and snacks was performed using repeated measures analysis of variance (ANOVA) followed by Tukey's test for multiple comparisons
- Frequencies of skipping each meal were determined using the three days of food records for every subject and reported as a percentage of the total number of subjects skipping one, two, three, or zero days
- The average number of daily snacks consumed was computed using the three days of food records for every subject and the frequency of subjects consuming an average of at least one snack per day was computed
- Categories for average eating occasion frequencies (total number of daily meals and snacks) across the three days of food records were created as at least three, four, five or more than six eating occasions per day and used for comparison of energy intake and BMI using repeated measures ANOVA followed by Tukey's test for multiple comparisons
- The percentage of subjects within each BMI-for-age percentile body weight category was also compared among the four eating occasion frequency categories
- Relation of breakfast consumption to energy and nutrient intakes was evaluated by categorizing subjects into consistent (consumed breakfast all three days) or inconsistent (skipped breakfast at least one of the three days) breakfast consumers and comparing their three-day average nutrient intakes and BMI using unpaired Student's T-test and a Bonferonni correction for multiple comparisons
- The percentage of subjects within each BMI-for-age percentile body weight category was also compared between consistent and inconsistent breakfast consumers.

Data Collection Summary:

Timing of Measurements

This study utilized a one-time data collection of a three-day food diary.

Key Study Variables

- BMI
- Eating occasion
- Energy and nutrient intakes, including:
    - Energy (kcal)
    - Protein (g)
    - Carbohydrate (g)
    - Total fat (g)
    - Saturated fat (g)
    - Cholesterol (mg)

- Dietary fiber (g)
- Calcium (mg)
- Iron (mg)
- Sodium (mg).

Description of Actual Data Sample:

- *Initial N:* 180 (all males)
- *Attrition (final N):* 180 (one time data collection)
- *Age:* 14-18 years old (mean age 15.3 (SD 1.21)
- *Ethnicity:* Not stated
- *Anthropometrics:* Only one group
  - Of the 180 subjects, 66% had acceptable body weight
  - 19% were at risk for overweight
  - 16% were considered overweight
- *Location:* Ontario, Canada.

Summary of Results:

When comparing energy and nutrient intakes among breakfast, lunch, dinner and snacks, dinner was the largest contributor of:

Energy	887.8kcal	±24.8
Protein	43.5g	±1.23
Carbohydrate	101.3g	±3.19
Total fat	34.3g	±1.31
Saturated fat	10.4g	±0.46
Cholesterol	102.6mg	±4.70
Dietary fiber	4.88g	±0.22
Sodium	1,766mg	±65.3

- Dinner and breakfast were the largest contributors of: Calcium 328.8mg (±19.4) and 299.0mg (±16.0), respectively and iron 4.50 (±0.20) and 5.39 (±0.35)
- Breakfast on the other hand, was the smallest contributor of:

Energy	456.7kcal	±18.0
Carbohydrate	70.5g	±3.11
Total fat	12.6g	±0.68

Saturated fat	4.38g	±0.24

- Lunch contributed approximately 25% of energy and nutrient intakes, which was significantly less than dinner and significantly greater than breakfast for energy and all nutrients except cholesterol
- Snacks tended to contribute fewer nutients than meals (although only cholesterol and iron were significantly lower)
- 26% of study subjects reported skipping breakfast and 26% of subjects reported skipping lunch at least once (in three recorded days.) Dinner was the least frequently skipped meal
- The majority of study subjects (77%) consumed at least one snack per day. Mean number of snacks consumed daily was 1.68
- Regarding eating occasion, 32% of subjects consumed no more than three eating occasions per day, 39% had four, 9% had five and 20% had at least six eating occasions per day.

Author Conclusion:

The authors conclude that this study provides valuable information regarding eating occasion frequency and contribution of meals and snacks to energy and nutrient intakes in adolescent males. Such information could be used to improve nutrition education programs for adolescents aimed at chronic disease prevention.

Reviewer Comments:

- *No funding source given*
- *Physical activity not assessed, so it is unclear how much energy was expended through exercise*
- *Social desirability may have lead to some over- and under- reporting*
- *Potential of population bias: Those who participated were motivated and received support*
- *No ethnicity or social economic status data collected.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes

4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes

4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A

7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	N/A
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	No
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes